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Retrieving Cloud Properties for Multilayered Clouds Using Simulated GOES-R Data

Fu-Lung Chang[1], Patrick Minnis[2], Bing Lin[2], Rabindra Palikonda[3], Mandana Khaiyer[3], Sunny Sun-Mack[3], Ping Yang[4]

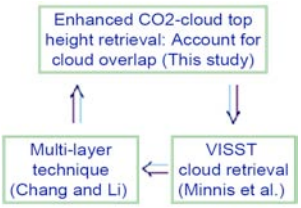
1) National Institute of Aerospace (NIA, Virginia), 2) NASA Langley Research Center, 3) Science System Applications Inc., 4) Texas A&M University

Introduction

This study presents a multi-spectral satellite retrieval algorithm for retrieving the multi-layered cloud properties. The retrievals are presented by applying to current satellite data available from GOES-12, -13, Meteosat-8, -9, and MODIS. The GOES-R and new series of satellite imagers have all added at least one (13.3-μm) CO2-absorbing channel to allow for an enhanced CO2-multilayered cloud retrieval algorithm.

Algorithm

An enhanced 11μm/13.3μm CO2-cloud retrieval technique that corrects for the underlying lower clouds in the multi-layer cloud situation. An iteration is applied:



Summary

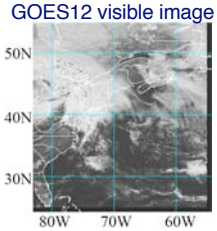
- The new 11.0/13.3-μm-CO2 absorbing technique improves the geostationary satellite retrieval for uppermost cloud top height.
- The integrated CO2-VISST-Multilayer algorithm enhanced the retrievals of multi-layered cloud properties.
- The algorithm is applicable to the geostationary satellites like GOES-12, GOES-13, MSG-SEVIRI, MTG-SEVIRI, and future GOES-R, and to polar-orbiting MODIS instruments as well.
- Future work will include the algorithm refinements and retrieval validations.

GOES-12 (U.S. EAST)

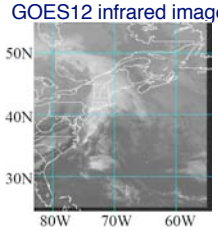
Starting with the U.S. GOES-12 (GOES-EAST) in a series of new GOES imagery satellites, a 13.3-μm CO2-absorption channel has been added to replace the original 12-μm channel.

Case Study: 2007/04/04
GOES-12 (UTC 1745) & MODIS (UTC 1750)

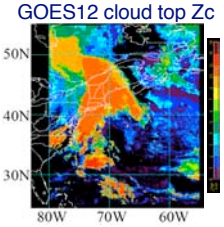
GOES12 visible image



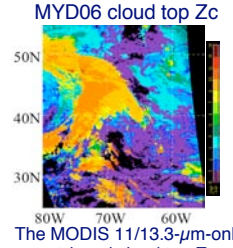
GOES12 infrared image



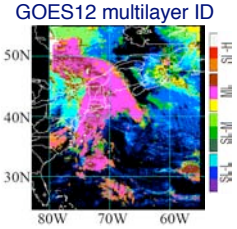
GOES12 cloud top Zc



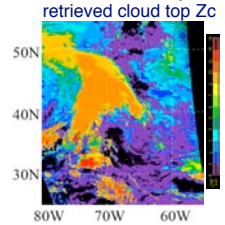
MYD06 cloud top Zc



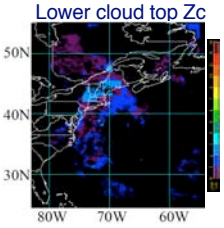
GOES12 multilayer ID



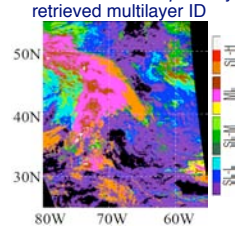
The MODIS 11/13.3-μm-only retrieved cloud top Zc



Lower cloud top Zc



The MODIS 11/13.3-μm-only retrieved multilayer ID

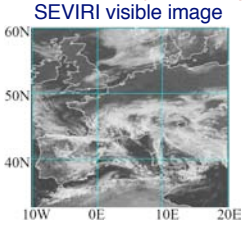


Meteosat-8 SEVIRI (Europe)

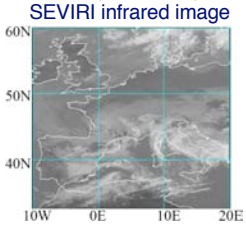
The European new geostationary satellites, starting with Meteosat-8, Meteosat Second Generation (MSG) SEVIRI, also add a 13.4-μm CO2 absorbing channel.

Case Study: 2007/04/04 Meteosat-8
SEVIRI (UTC 1300) & MODIS (UTC 1250)

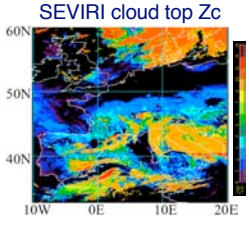
SEVIRI visible image



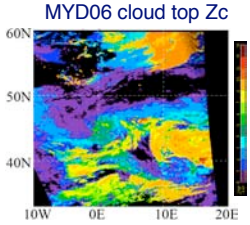
SEVIRI infrared image



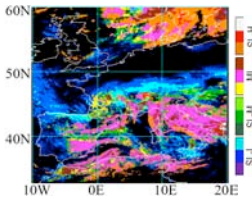
SEVIRI cloud top Zc



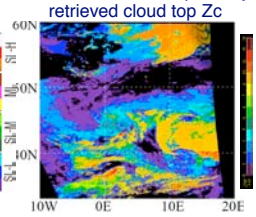
MYD06 cloud top Zc



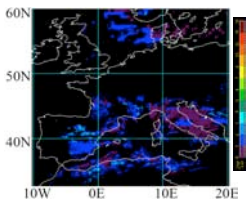
SEVIRI multilayer ID



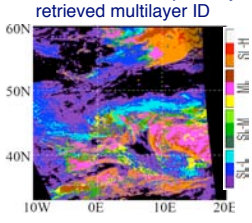
The MODIS 11/13.3-μm-only retrieved cloud top Zc



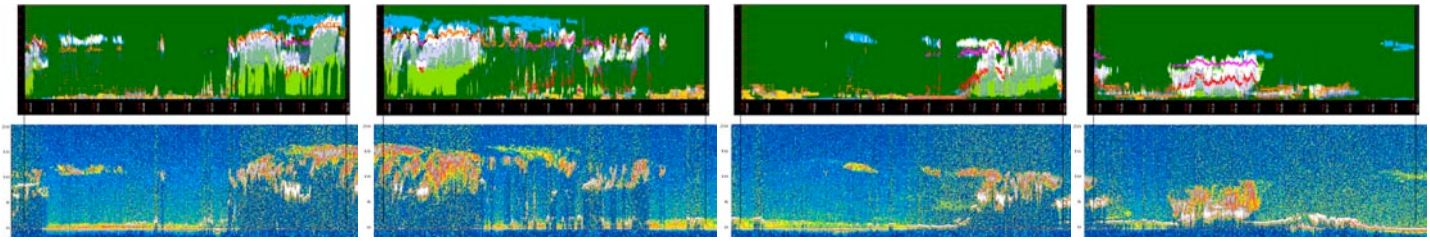
Lower cloud top Zc



The MODIS 11/13.3-μm-only retrieved multilayer ID



First Retrieval Comparisons with CALIPSO/CloudSat Product 2007/04/04 (Orange single layer, Pink upper layer, Red lower layer)



Contact: fu-lung.chang-1@nasa.gov

References: Chang, F.-L., and Z. Li, 2005; Minnis et al., 1998, 1995; Wielicki and Coakley, 1981.